UNITED STATES DEPARTMENT OF AGRICULTURE
Weather Bureau
Washington

March 28, 1936.

Office of the Chief

AMENDMENT TO CIRCULAR "TRANSMISSION OF AIR MASS AND FRONTAL ANALYSES BY TELETYPE AND RADIO" DATED OCTOBER 15, 1935.

The following amendments to the Circular "Transmission of Air Mass and Frontal Analyses by Teletype and Radio", dated October 15 1935, will become effective on April 10, 1936:

Page 3, add to the symbols representing the types of fronts, the following:

/⊕/ .....Warm front aloft

/◑/.....Cold front aloft

/◐/.....Occluded front aloft

◑⊖.....Stationary front (e. g. cold front that has stopped moving and may reverse direction to become a warm front)

◑+.....Cold front frontogenesis (new front forming at surface, probably increasing in intensity)

⊕+.....Warm front frontogenesis

Page 3, in the list of air masses and their numbers, change number 8 from tropical superior (Ts) to superior (S). This more general name has been found to apply better to this type of air. The change of name should be made elsewhere in the circular where it appears.

Page 4, add to the paragraph which is continued from page 3, the following:

"In the case of a front aloft, the air masses aloft on either side of the front will be given in addition to the surface air mass. For example, 1/2/0/1/4 would mean that there is polar continental air at the surface above which is a cold front acting between polar Pacific and transitional polar Pacific."

Page 4, last paragraph, add: "A front aloft will be designated by a broken line using the same system of colors as for surface fronts. A stationary front will be represented by a line consisting of alternate, connected segments of red and blue, each about half an inch in length. A line of frontogenesis will be indicated by a heavy dotted line of red or blue, depending on whether the front being formed is a warm or cold front."

Experience indicates that the additions and changes are necessary in order that complete analyses of the air mass and frontal situations may be furnished.

W. R. Gregg,
Chief of Bureau.

UNITED STATES DEPARTMENT OF AGRICULTURE
WEATHER BUREAU
Washington

Office of the Chief

October 15, 1935.

CIRCULAR

TRANSMISSION OF AIR MASS AND FRONTAL ANALYSIS
BY TELETYPE AND RADIO

The transmission by teletype and radio of the analysis of the morning weather map in accordance with the air mass system as now practiced in the Division of Meteorological Physics at the Central Office, will begin October 15th. The data will be transmitted in code for entry on the manuscript maps as prepared at the various airport stations. This circular, describing the code and the practice to be followed in utilizing the information, is being sent to all stations.

The results of the air mass and frontal analysis of the morning map will be placed on the teletype circuit at Washington daily, except Sundays and holidays, at 11:30 a.m., Eastern Standard Time, and will be relayed to all airway communication circuits. Data for Sundays and holidays will be transmitted on the next working day immediately following the current day's analysis.

The transmission of information for preparing air mass maps has been decided upon, following the suggestion of field personnel who are eager to obtain the benefits of the application of air mass analysis now being made at the Central Office. Furthermore, it has been brought to the attention of the Chief of Bureau and the division heads in the Central Office that the field personnel has taken an active interest in air mass analysis and that many of the men have voluntarily done a considerable amount of reading and study on the subject. It is felt, however, that no amount of reading and study can take the place of actual practice in map analysis. In order to provide a basis for such practice there must be a method of checking individual deductions against those of a thoroughly trained air mass analyst. It is expected that the transmission each morning of the position of the fronts and air masses will accomplish this purpose.

Upon receipt of the coded analysis, it is to be decoded and entered on the map of 8 a.m., E. S. T. Using this as a basis, the employees are encouraged to carry through the sequence of air mass and front movements according to their own analyses on the 6-hourly maps. This should be done with the utmost care, paying particular attention to following a logical historical sequence. The drawing of the 8 a.m. map should not be delayed until receipt of the authoritative analysis by teletype, but should be completed as soon as possible. Fronts and air masses according to an analysis made by a qualified employee may be entered on this map but corrections must be made later on the office manuscript map when the analysis is received from Washington. Such corrections need not be made

on the carbon or duplicated copies which were distributed before receipt of the coded message. While the continuation of the sequence of developments on the 6-hourly maps is encouraged, caution is advised against interpreting conditions too positively until considerable skill to be gained only by practice and experience is attained.

Only those fronts and air masses which give strong evidence of their existence will be transmitted. For this reason, field personnel will in some cases detect fronts which are not given in the authoritative analysis, but the paths of caution and conservatism should be followed in such cases. Furthermore, in the most careful initial analyses by skilled personnel, slight errors occur, but in most cases they are soon corrected. The possibility of error is especially great in the western portion of the weather map, where, on account of the absence of data from farther west, the historical sequence of events cannot be followed and identifications must be made solely on the basis of current indications. Therefore, less accuracy in the maps will be attained for the Pacific Coast.

It is expected that this new phase of the air mass program of the Bureau will stimulate greater interest in the subject and that discussion and constructive criticism of the analyses will arise. It would be of decided benefit to the personnel if questions could be answered and criticisms be discussed by the men engaged in the air mass work at the Central Office. Unfortunately, however, the force is entirely inadequate for such a program of discussion and criticism. Therefore, it is requested that the analysis, as transmitted, be accepted as authoritative and questioned only in cases of major importance where the evidence refutes the analysis as given. It should be remembered that most errors will be corrected later and that two analyses which appear different, may give essentially the same result as far as interpretation and application to forecasting are concerned.

Another point which should be kept in mind is that descriptions of frontal conditions appearing in the literature usually apply to idealized active situations where large quantities of moisture are involved. It should be realized that the same fundamental principles of physical meteorology apply to air mass analysis as to any other method and that precipitation and clouds cannot form in relatively dry air, regardless of the strength of the interaction. Furthermore, fronts often pass with but little effect on the surface temperatures. For these reasons, many front passages have little influence on the more important weather conditions in any given region. Forecasting on the basis of fronts and their movements should not be attempted until a sufficient amount of experience and understanding in dealing with fronts and air masses is attained.

The transmissions by teletype and radio will be made as follows:

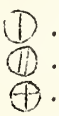
The heading of the transmissions will consist of the Washington designator; the symbol "AMAFA" meaning "air mass and frontal analysis"; the time; and the date of the map analyzed, using figures. For example:

"WA AMAFA 080001..." would be translated as "Washington air mass and frontal analysis of the 8 a.m. E. S. T. map, October 1, 1935".

Following the heading will be one space and then a type-of-air-mass-and-front symbol group, in which the numbers will indicate the type of air masses lying on either side of the front and the circular symbol will indicate the type of front separating these air masses. The numbers representing the types of air mass and the abbreviations for the air mass names will be as follows:

1.....Polar Continental (Pc)
2.....Polar Pacific (Pp)
3.....Transitional Polar Continental (Npc)
4.....Transitional Polar Pacific (Npp)
5.....Tropical Gulf (Tg)
6.....Tropical Pacific (Tp)
7.....Tropical Atlantic (Ta)
8.....Tropical Superior (Ts)
9.....Transitional Tropical Pacific (Ntp)
10.....Transitional Tropical Maritime (Ntm)
11.....Transitional Mixed Polar Pacific and Polar Continental (Np)
12.....Tropical Maritime-Exact source unknown (Tm)

The symbols representing the types of fronts will be as follows:

 .....Cold Front
.....Occluded Front
.....Warm Front

The type-of-air-mass-and-front group will consist of an air mass designating number, the type of front symbol and another air mass designating number, in the order named. If more than one air mass is present on either side of the front, one being at the surface and the other aloft, this will be indicated by entering the symbol number for the surface air mass followed by an oblique and then the symbol number for the air mass aloft. Also, if there is more than one type of air mass present at the surface on either side of the front, this will be indicated by a symbol for the dominating type followed by a plus sign and the symbol number for the second type of air mass. Further, if one type of air mass is changing to another type, this will be indicated by a symbol number for the air mass which is changing, followed by an arrow and then a symbol number indicating the type of air mass to which the first is changing.

The first air mass number or numbers in any type-of-air-mass-and-front symbol group will indicate the air mass or masses to the left of the line of the front, assuming that in all cases the progress of the line from its point of beginning is toward the observer, i.e., if a line is being drawn generally from the southwest to the northeast, the first symbol number or numbers would be for the air mass or masses to the south of the line and the second symbol number or numbers for the air mass or masses to the north of the line. Again, if the line is being drawn generally from the northeast to the southwest, the first symbol number or numbers would be for the air

mass or masses to the north of the line and the second symbol number or numbers for the air mass or masses to the south of the line. For example, "1◑2", would indicate a Polar Continental air mass to the left of a cold front separating it from a Polar Pacific air mass to the right of the front; "3◓7/8" would indicate a Transitional Polar Continental air mass to the left of a warm front separating it from a Tropical Atlantic air mass at the surface with a Tropical Superior air mass aloft to the right of the front; "3◑4→5" would indicate a Transitional Polar Continental air mass to the left of a cold front separating it from a Transitional Polar Pacific air mass changing to a Tropical Gulf air mass to the right of the front; "5+8◍10" would indicate a Tropical Gulf intermixed with a Tropical Superior air mass to the left of an occluded front separating it from a Transitional Tropical Maritime air mass to the right of the front, etc.

Following the type-of-air-mass-and-front-group will be an oblique and then the latitude and longitude, in the order named, of the beginning point of the front, followed by the latitude and longitude of one or more (as many as are necessary to properly outline the position of the front) significant points on the front, the group of figures representing the latitude and longitude of any particular point being separated from the next group by an oblique. Thus, "48105/4590" would indicate latitude 48° and longitude 105° for the beginning point, and latitude 45° and longitude 90° for the second point, etc. The points will, in general, be sent in the order in which they occur from the top to the bottom of the map for fronts extending generally north and south and from the left to the right for fronts extending generally east and west.

If a front is continuous but the type of air mass on either or both sides of it changes, a new type-of-air-mass-and-front symbol group will be inserted preceding one of the points without spacing to indicate that the type of air mass on one or both sides of the front will be different from that point on. Also, if a series of fronts are located with respect to each other so as to form a continuous smooth line, the transmission for the entire series will be made without a break or dash, but a new type-of-air-mass-and-front symbol group will be inserted before each latitude and longitude group where the type of front changes. Further, if one front is attached to another at an acute angle and is plainly not a part of a continuous smooth front, or a continuous series of fronts, the latitude and longitude of the connecting point will be given in the first series of points in its proper order and also the second series of points will either begin or end with the latitude and longitude of the connecting point.

Each front, or series of fronts, representing a single continuous smooth line, on a particular map will be set-off by two dashes in the transmission separating it from data for other continuous fronts preceding it in the transmission.

Blue will be used for indicating cold fronts, purple for occluded fronts, and red for warm fronts on the air mass maps prepared at stations.

The following method will be followed by employees entering data on the maps:

1. The type-of-air-mass-and-front-symbol group will be examined and the type of front determined.

2. The location of the first point on this front will then be determined from the first latitude and longitude given after the type-of-air-mass-and-front symbol group.

3. This point will then be entered on the map using the proper color for the type of front to be entered and succeeding points entered as indicated by the latitude and longitude groups given, using the proper color for the type front involved.

4. The proper air mass symbols will then be entered on either side near the middle of the front, using blue for polar symbols and red for tropical symbols, the first air mass symbol or symbols given in the type-of-air-mass-and-front symbols group being placed to the left of the line as it progresses toward the person making the map and the second air mass symbol or symbols being placed to the right of the line.

5. The same procedure will then be followed for all other fronts given in the transmission, and after these have been entered, a line of the proper color (for the time being, heavy red for warm fronts, blue for cold fronts, and purple for occluded fronts) will be drawn through the points representing each front. Green will not be used for wind-shift lines. In doing this it should be noted that where the line of a series of fronts is continuous (the points changing in color where the type of front changes) each colored line representing the type of front in the continuous series should be drawn up to the point where the front changes or in other words, up to the new colored point in the line. This same procedure will obtain for each undashed transmission of a continuous line.

Under the foregoing plan, it will be seen that each front or series of fronts forming a continuous line in themselves but which do not form a continuous line with the fronts preceding them in the transmission, will be separated by a double dash. (e. g. a front or continuous series of fronts joined to another front or continuous series of fronts at an angle, or separated entirely from other fronts or series of fronts.) This is a mere mechanical rule adopted in transmitting the analysis in order to aid in its translation, but in order that no confusion may arise in the event that a space or dash is inadvertently transmitted or omitted, it should be remembered that each separate front or change of air mass transmission begins with a type-of-air-mass-and-front symbol group. Also, the latitude and longitude groups, if correct, will require the connecting of such points. Continuation of a front line, the data for which require more space for transmission than one line on a page-type printer, will be indicated by the presence of an oblique at the end of the line.

No difficulty at any of the stations in locating the points accurately and rapidly from the latitudes and longitudes given is anticipated, as experiments at the Central Office indicate that the intervals of latitude and longitude in use are entirely adequate for this purpose, provided a little care is used in estimating distances between them.

The fronts will be entered on the 8 a.m. maps prepared at airport stations on teletype circuits and will be projected forward to other maps prepared during the ensuing 24 hours, i. e., the fronts shown on the 8 a.m. map will each be entered on succeeding maps in the position shown by the data as the correct one for that particular line. The fronts will also be placed lightly on the next succeeding 8 a.m. map, prior to the receipt of the analysis but will then be corrected to fit the analysis if any considerable error exists. In all cases the fronts should be drawn in first and the isobars then drawn to fit.

The maps thus prepared will be displayed for the benefit of all concerned exactly as is now done with the regular 8 and 2 a.m. and p.m. maps.

In making carbon copies, the following procedure will be observed. The data will be entered on the original map with the black carbon inserted. The black carbon will then be removed and the fronts entered on the original map, after which the black carbon paper will be reinserted and the isobars drawn in, these being drawn, of course, to fit the fronts. The black carbon paper will then be removed and the fronts drawn in, <u>in color</u>, on each carbon copy.

There follows a fictitious example to illustrate the use of the code:

WA AMAFA 080001 2@1/62170/63160/4@1/65154/67145/11@1/
64130/60116/11@1/6390/6680/6573/6369/5767--4/9@11/58120/55114/50112/
4@11/47105/42103/36105/31108/29105/31100/2998--4@4/2998/20108--
11@11/4886/4382/4373/7@11/4171/3665/3562--4/5@5/4171/3580/11@5/
3393/3296/4@5/2998/2599/2097--11@4/5/4171/3780/3585/3393

which translated would read:

"A cold front separating Polar Continental air to the north from Polar Pacific air to the south begins at latitude 62° and longitude 170°, running through latitude 63° and longitude 160°, changing to a warm front at latitude 65° and longitude 154°, separating Polar Continental air to the north from Transitional Polar Pacific air to the south. The warm front continues through latitude 67°, longitude 145°, and changes to a cold front at latitude 64°, longitude 130°, which separates Polar Continental air to the north from Transitional Mixed Polar Pacific and Polar Continental air to the south. The cold front continues through latitude 60°and longitude 116°, changing to a warm front at latitude 63°and longitude 90°. The warm front which separates Polar Continental air to the north from Transitional Mixed Polar Pacific and Polar Continental air to the south continues through points at latitudes 66°, 65°, 63° and longitudes 80°, 73°, 69°, respectively,

ending at latitude 57° and longitude 67°.

"An occluded front separating Transitional Polar Pacific air overlain by Transitional Tropical Pacific air to the west from Transitional Mixed Polar Pacific and Polar Continental air to the east begins at latitude 58°, longitude 120° and continues through points at latitude 55°, longitude 114°, and latitude 50°, longitude 112°, to latitude 47°, longitude 105° where it separates Transitional Polar Pacific air to the west from Mixed Polar Pacific and Polar Continental air to the east. The occluded front continues through latitudes 42°, 36°, 31°, 29°, 31° and longitudes 103°, 105°, 108°, 105°, 100°, respectively, ending at latitude 29°, longitude 98°.

"A cold front separating Transitional Polar Pacific air to the west from Transitional Polar Pacific air to the east begins at the point where the occluded front ended and extends to latitude 20° and longitude 108°.

"An occluded front separating Transitional Mixed Polar Pacific and Polar Continental air to the north from the same type of air to the south, begins at latitude 48°, longitude 86°, and continues through points at latitude 43°, longitude 82°, and latitude 43°, longitude 73°, to latitude 41°, longitude 71°, where a cold front begins, separating Transitional Mixed Polar Pacific and Polar Continental air to the north from the Tropical Atlantic air to the south and continues through latitude 36°, longitude 65°, ending at latitude 35°, longitude 62°.

"A cold front separating Transitional Polar Pacific at the surface with Tropical Gulf air aloft to the north from Tropical Gulf air to the south, begins at latitude 41°, longitude 71°, and continues through latitude 35°, longitude 80°, changing to a warm front at latitude 33°, longitude 93°, where it separates Transitional Mixed Polar Pacific and Polar Continental air to the north from Tropical Gulf air to the south. The warm front continues from that point through points at latitude 32°, longitude 96° to latitude 29°, longitude 98°, where it separates Transitional Polar Pacific air to the west from Tropical Gulf air to the east and continues on through latitude 25°, longitude 99°, and ends at latitude 20°, longitude 97°.

"A second cold front separating Transitional Mixed Polar Pacific and Polar Continental air to the north from Transitional Polar Pacific air overlain by Tropical Gulf air to the south, begins at latitude 41°, longitude 71°, and continues through points at latitude 37°, longitude 80°, and latitude 35°, longitude 85°, ending at latitude 33°, longitude 93°".

It is regretted that lack of funds makes it impracticable to telegraph the analyses to stations that are not connected with Department of Commerce teletype and radio system. The official in charge at Jacksonville is authorized and requested to secure the analysis from the airport station and transmit it on the hurricane teletype system for city offices connected therein and nearby airport stations during the hurricane season whenever it does not interfere with transmission of essential storm information. Officials in charge of other city (and airport) offices may secure the

information from nearby airport stations by telephone when no toll is involved, or by mail from the nearest airport station. Officials in charge of airport stations are authorized to comply with such requests by copying the analyses with pencil and using carbon paper to produce the quired number of copies, or if only one copy is required, the original teletype copy may be mailed.

Entry of fronts and air mass symbol letters on maps at city offices is not obligatory.

C. C. Clark,
Acting Chief of Bureau.